

Applicant: Pironi, et al.

Application No.: 09/839,759

Docket No: 1085-2

Page 5

REMARKS

Claims 1-5 and 7-15 are pending. Independent claims 1, 12 and 14 have been amended to further describe the methane, ethane and propane content of the hydrocarbon gas feed stream of the inventive process. Accordingly, claim 6 has been cancelled without prejudice.

By way of review, the present invention is directed towards a process for recovering ethane, such as high purity ethane gas, from a hydrocarbon gas stream. The hydrocarbon gas stream is separated into a methane-rich gas stream, an ethane-rich gas stream and a propane-rich stream. The hydrocarbon gas stream is cooled by refrigeration prior to separating it into the methane-rich stream and an ethane/propane-rich stream, which is separated into the ethane-rich stream and the propane-rich stream.

The methane-rich stream is expanded to reduce its pressure and to reduce its temperature, thereby providing a cool methane-rich stream. The cool methane-rich stream is the refrigeration source for cooling the hydrocarbon gas stream. Such cooling occurs in the cryogenic heat exchanger 223.

Such an inventive process efficiently provides ethane-rich streams from both lean gas streams (low concentrations of hydrocarbons heavier than methane) and rich gas streams (high concentrations of hydrocarbons heavier than methane).

Applicant: Pironi, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 6



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ARGUMENTS

Claims 1-5, 12 and 14 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,125,653 to Shu et al. (hereinafter "Shu"). Applicants respectfully traverse.

Shu is directed toward a process for producing liquefied natural gas (LNG) from a hydrocarbon gas stream. The LNG is a liquefied methane stream obtained by cooling a gaseous methane stream from the demethanizer column. (Shu, col. 3, line 59, to col. 3, line 25). An ethane rich gas stream from the demethanizer column may also be liquefied and added to the liquefied methane stream. (Shu, col. 4, lines 26-38). Refrigeration cycles are used to cool these overhead gas streams, as well as for cooling recycled vapor streams. See, e.g., Shu; col. 2, lines 10-14; col. 3, lines 39-43; col. 4, lines 63-65; and col. 5, lines 2-5).

In the process of Shu, the gas feed 1 is precooled in feed exchanger 102 by heat exchange with cold methane vapor (not shown). The precooled gas is expanded in feed expander 104. Feed exchanger 102 and feed expander 104 reduce the temperature of the gas feed from 110°F to -89°F. (Shu, col. 3, lines 27-36).

The cold methane gas 5, which is the cooling source for feed exchanger 102, results from the turbo-expanded (via turbo-expander 118) overhead fraction 3 from the demethanizer column

Applicant: Pironi, et al.

Application No.: 09/839,759

Docket No: 1085-2

Page 7

108. The overhead fraction 3 is described as being nearly pure methane. (Shu, col. 3, lines 59-65).

The gas feed 1, however, contains a very high concentration of methane, *i.e.*, about 90 mole percent. Such a concentration is apparent from Table 1 where the demethanizer overhead 3, which is described as being nearly pure methane, has a rate of 94,600 lb-mols/hr and the gas feed 1 has a rate of 105,608 lbs-mols/hr ($100 * 94,600 \div 105,608 = 89.6\%$). Additionally, only about 790 lbs-mols/hr of methane is contained in the 6,300 lb-mols/hr de-ethanizer overhead 4, which is described as containing one part methane to seven parts ethane at col. 4, lines 27-29. Thus, the total amount of methane in the gas feed is 94,600 lb-mols/hr plus 790 lb-mols/hr, which equals 95,390 lb-mols/hr or 90.3 mole percent on a gas feed 1 basis. ✓

Thus, Shu expands a feed gas stream having 90 mole percent methane to cool the stream in conjunction with other cooling.

In contrast, the present invention, as set forth in amended independent claims 1, 12 and 14, is a process for recovering ethane from a hydrocarbon gas stream comprising from about 40 to about 80 mole percent methane. Such a feed stream has significantly less methane than the feed stream of Shu. Thus, the feed stream of the present invention contains substantially greater amounts of ethane and heavier hydrocarbons than the feed stream of Shu.

Applicant: Pironti, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 8

Moreover, as described in paragraph 7 of the specification, gas streams containing significant amounts of hydrocarbons heavier than methane cannot be sufficiently cooled by direct turbo expansion because these heavier hydrocarbons would condense. Such condensation results not only in poor efficiency of the turbo expander, which results in poor energy efficiency, but also results in inefficient cooling of the stream because much of the enthalpy resulting from expansion is lost in the condensation of gaseous constituents into liquid constituents as opposed to the necessary and desirable cooling of the gaseous constituents. Thus, the process of Shu would likely be inoperable for gas streams having hydrocarbon components as set forth in the amended claims.

Furthermore, the process of the present invention heats the demethanizer overhead stream, which is in direct contrast to the process of Shu which cools its demethanizer overhead at exchanger 114. (See, e.g., Illustrations 1 and 2 below). The heating of the demethanizer overhead stream in the process of the present invention provides, *inter alia*, the cooling source for the cryogenic heat exchanger 223. Thus, the numerous refrigeration cycles of Shu are not present in the present invention.

? not in the claims

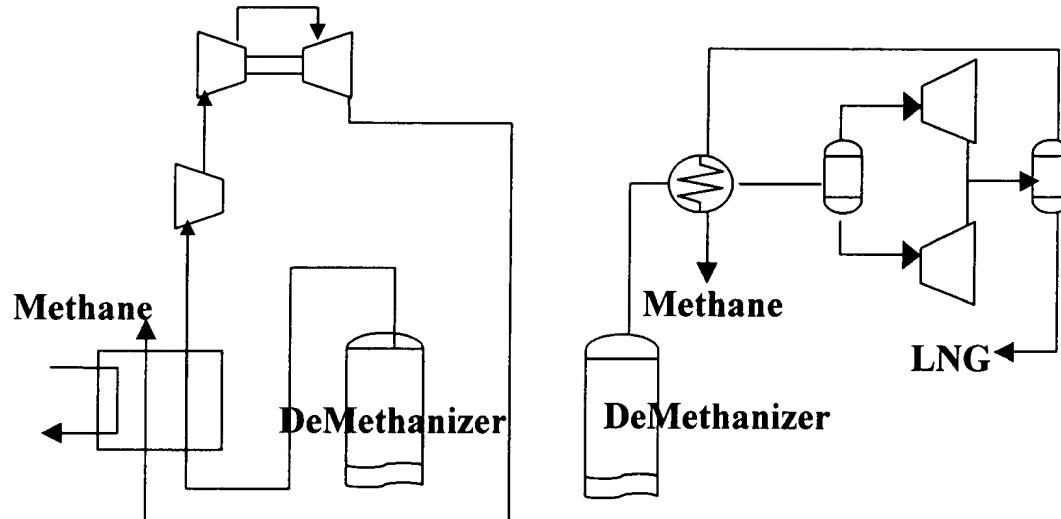


Illustration 1
(Present
Invention)

Illustration 2
(Shu et al)

Still furthermore, the present invention is directed towards the recovery of high purity ethane, *i.e.*, containing at least 90 mole percent methane. In contrast, Shu fails to disclose a process for producing such a high purity ethane stream. Indeed, the demethanizer overhead of Shu contains considerable methane in the ethane stream, for example one part methane to seven parts ethane. (Shu, col. 4, lines 28-29).

Thus, Shu is directed to an entirely different process than the preset invention. Shu is directed towards the recovery of liquid methane from a very rich methane source. The present

Applicant: Pironti, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 10

invention is directed towards the recovery of high purity ethane from a hydrocarbon source containing considerably more hydrocarbons heavier than methane as compared to the methane-rich feed of Shu. In fact, the process of Shu would not be operable with such heavier hydrocarbons due to cooling constraints for the Shu process.

Thus, Shu fails to disclose the present invention because Shu fails to disclose an ethane recovery processing having, *inter alia*, a gas feed stream with about 40 to about 80 mole percent methane. Moreover, Shu fails to teach or suggest the present invention because the gas stream of the present invention, which comprises from about 40 to about 80 mole percent methane, is significantly different from the 90 mole percent methane stream of Shu. Shu fails to teach or suggest that its process could be operable for such a feed stream as claimed in the present invention.

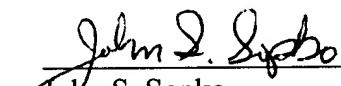
Therefore, Shu fails as a *prima facie* reference for a rejection under 35 U.S.C. §102 and §103. Thus, reconsideration and withdrawal of the rejections of independent claims 1, 12 and 14, and all claims dependent therefrom, are respectfully requested.

In view of the foregoing, it is apparent that the present invention is allowable over the prior art and is in condition for allowance. Reconsideration and favorable action are therefore respectfully requested.

Applicant: Pironiti, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 11

Should the Examiner have any questions or concerns regarding any of this information, the Examiner is encouraged to contact Applicants' undersigned representative at (973) 331-1700.

Respectfully submitted,


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Applicant: Pironi, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 12

VERSION OF AMENDMENT WITH MARKINGS
SHOWING CHANGES

IN THE CLAIMS:

Claims 1, 12 and 14 have been amended as follows:

1. (Amended) A process for recovering ethane from a hydrocarbon gas stream having methane, ethane and propane comprising:
providing the hydrocarbon gas stream comprising from about 40% to about 80 % by mole methane, from about 10% to about 50 % by mole ethane and from about 0.5% to about 10 % by mole propane;
cooling the hydrocarbon gas stream by refrigeration to form a cooled hydrocarbon gas stream;
separating the cooled hydrocarbon gas stream into a methane-rich stream and an ethane/propane-rich stream, said methane-rich stream having a first pressure and a first temperature;
expanding said methane-rich stream from said first pressure to a second pressure to lower the temperature of said methane-rich stream from said first temperature to a second temperature to provide a cooling source for said refrigeration, wherein said second pressure is lower than said first pressure and further wherein said second temperature is lower than said first temperature;
separating said ethane/propane-rich stream into an ethane-rich stream and a propane-rich stream; and
recovering said ethane-rich stream.

Applicant: Pironzi, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 13

12. (Amended) A process for recovering ethane from a methane, ethane and propane containing gas stream comprising:

providing the hydrocarbon gas stream comprising from about 40% to about 80 % by mole methane, from about 10% to about 50 % by mole ethane and from about 0.5% to about 10 % by mole propane;

cooling the hydrocarbon gas stream in a cryogenic heat exchanger to form a cooled hydrocarbon gas stream;

distilling the cooled hydrocarbon gas stream in a demethanizer column to form a methane-rich stream and an ethane/propane-rich stream;

compressing said methane-rich stream to form a compressed methane-rich stream;

cooling said compressed methane-rich stream to form a compressed methane-rich stream;

turboexpanding said compressed methane-rich stream to a lower pressure to provide a cooling source for said cryogenic heat exchanger;

distilling said ethane/propane-rich stream in a de-ethanizer column to form an ethane-rich stream and a propane-rich stream; and

recovering said ethane-rich stream.

14. (Amended) A process for providing a methane-rich stream from a hydrocarbon stream containing methane, ethane and propane comprising:

providing the hydrocarbon gas stream comprising from about 40% to about 80 % by mole methane, from about 10% to about 50 % by mole ethane and from about 0.5% to about 10 % by mole propane;

cooling the hydrocarbon gas stream by refrigeration to form a cooled hydrocarbon gas stream;

separating the cooled hydrocarbon gas stream into a methane-rich stream and an ethane/propane-rich stream, said methane-rich stream having a first pressure and a first

Applicant: Pironi, et al.
Application No.: 09/839,759
Docket No: 1085-2
Page 14

temperature;

expanding said methane-rich stream from said first pressure to a second pressure to lower the temperature of said methane-rich stream from said first temperature to a second temperature to provide a cooling source for said refrigeration, wherein said second pressure is lower than said first pressure and further wherein said second temperature is lower than said first temperature;

recovering said methane-rich stream.

Claim 6 has been cancelled without prejudice.